



**PATENT**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

APPLICANT(S) : Charles A. Becker, et al.

TITLE : FLEXIBLE INTERCONNECT  
STRUCTURES FOR ELECTRICAL  
DEVICES AND LIGHT SOURCES  
INCORPORATING THE SAME

APPLICATION NO. : 10/063,104

FILED : March 21, 2002

CONFIRMATION NO. : 3459

EXAMINER : I. B. Patel

ART UNIT : 2841

LAST OFFICE ACTION : November 10, 2005

ATTORNEY DOCKET NO. : RD-29430  
GLOZ 2 00334

Cleveland, OH 44114

**DECLARATION UNDER 37 C.F.R. § 1.131**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

As persons signing below:

1. We, Charles Becker, Stanton Weaver and Thomas Stetcher, do hereby declare that we are inventors in the above-identified United States patent application, Serial No. 10/063,104.

2. We declare that on a date prior to January 16, 2002, the invention disclosed in the above-identified United States patent application was completed in this country.

3. To establish the date of completion of the invention of the subject application, the following documents are submitted as evidence:

Exhibit 1: A copy of a disclosure document describing the invention (6 pages). The dates have been redacted from the document;

Exhibit 2: A copy of a PowerPoint presentation that was attached to the aforementioned disclosure document (LED stick spot lamp.ppt);

Exhibit 3: A copy of a photograph that was attached to the aforementioned disclosure document (Pic00001.jpg);


Exhibit 4: A copy of a photograph that was attached to the aforementioned disclosure document (Pic00002.jpg);

Exhibit 5: A copy of a photograph that was attached to the aforementioned disclosure document (Pic00003.jpg); and


Exhibit 6: A copy of a photograph that was attached to the aforementioned disclosure document (Pic00005.jpg).

4. We hereby declare that the relevant documents and photographs attached at Exhibits 1-6 were prepared at least prior to January 16, 2002.

We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

  
Charles Becker

5/1/06  
(Date)

  
Stanton Weaver

4/28/06  
(Date)

  
Thomas Stetcher

5/1/06  
(Date)

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GE Confidential & Proprietary Information.  
This invention is being prepared for submission  
to the GE Patent And Legal Operation. Attorney  
work product may be contained herein.

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## GE Patent Disclosure Letter System

### DOCKET NUMBER

29430

### DOCKET DATE

\_\_\_\_\_

### TITLE OF INVENTION

Flexible Interconnect for Power LED lamps

### GE TECHNOLOGY AREA(S)

- GE Consumer & Industrial - Lighting (LBXX)

### Keywords:

- Electronics
- Light-Emitting Diodes
- Incandes. & Specialty Lamp
- Lighting Systems

### PROJECT NAME

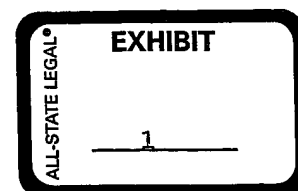
GELcore LEDs

### PROJECT NUMBER

212554

### PROJECT LEADER

Becker, Charles A.



**BUSINESS OR ORG. CONTACT INFORMATION****NAME** Bob Karlicek**PHONE NUMBER** 8\*343\*6590

**Was this invention first conceived or reduced to practice in the performance of work under a contract between GE and another non-government third party?** NO

**Date Invention Conceived :** [REDACTED]

**Circumstances Invention Conceived i.e., described in patent notebook (include page #), technical report, letter, discussed in meeting minutes, etc.**

Following discussions with LumiLeds sales representative at GELcore LLC. LumiLeds mounts their power LEDs on rigid metal PC boards, said to be developing FR4-board mounting in which LED protrudes through the board for attachment to heat sink.

**Was this invention first conceived or reduced to practice in the performance of work under a US Government contract?**  
NO

**ABSTRACT OF THE INVENTION**

**Please write a brief explanation of the invention (Limit to 350 words)**

The useable lifetime of a Light Emitting Diode (LED) is directly related to the device's operating temperature. The lower the device junction temperature the longer the device life. However the device optical output increases with an increase in electrical input power. In an effort to get the most optical output power from a device, innovative ways to decrease the thermal resistance from the package to the system heatsink must be invented. The invention uses a flexible circuit to make the electrical interconnect. A portion of the circuit is removed below the package heatspreader to allow the heatsink to extend through the circuit. The device is then directly contacted to the system heatsink. This removes the thermal impedance of the circuit interconnect. The flexible circuit's inherent thinness allows the package heatspreader to extend through the circuitry. The flexible circuit also allows unique 3-D applications to be constructed. Depending on the type of flex circuit, considerable savings may be realized.

**BACKGROUND OF THE INVENTION**

**Please describe the problem or requirement addressed by your invention.**

LED packages operating at high power require efficient

heatsinking methods. Circuit interconnect methods must the lowest thermal resistance to the system heatsink to insure device performance and lifetime. The invention reduces the thermal resistance from the device package to the overall system heatsink. This is done by removing the circuit area under the device. This is accomplished using thin flexible circuitry which is easily punched or laser cut. The circuit thinness allows the device heatsink to extend through the circuit with little or no additional leadforming required. The flexible circuitry also allows for unique 3-D lighting assemblies to constructed.

**How has this problem or requirement been addressed before?**

In typical assemblies, the device is mounted to a rigid, resin impregnated glass fiber (FR4) interconnect circuit. The board is then mounted to the system heatsink. In this case the board becomes a thermal barrier between the device and heatsink. An advanced approach uses thermal vias through the board in an area under the device. Other methods use thermal boards such as those produced by Bergquist Co.. The Bergquist board uses a metal board on to which a thin circuit is laminated using a thermally conductive epoxy. This improves thermal performance but at an increase in circuit cost.

**Is this disclosure letter related to any GE disclosure letters, patent applications or issued patents?**

NO

**Have you completed a prior art search? NO**

**Please list any relevant literature or patents of which you are aware.**

**DETAILED DESCRIPTION OF THE INVENTION**

**How does your invention work?**

The invention reduces the thermal resistance path of the LED to the system heatsink by eliminating the flexible circuit area under the device. This allows the device to be directly to the heatsink.

**Describe the important features of your invention and explain how to use the invention to solve the problems described above.**

Flexible circuitry, such as those made from polyimide, mylar, and polyester, are inherently thin. A typical circuit is 2mils but may even extend to thickness of 0.3mils. A cut out below the device allows the package heatspreader to extend through

and contact directly to the system heatsink. The areas may be removed from the circuitry using conventional cutting, punching, and laser cutting techniques. The inherent flexibility of the circuit also lends itself to the construction of unique 3-D lighting assemblies. Using polyester/conductive ink flex circuits will result in considerable cost savings.

**What advantages are provided by your invention?**

The advantages are improved thermal performance.  
Improved device lifetime. Direct connection of the device heatspreader to the heatsink through the thin flexible circuit.  
Ability to make 3-D lighting assemblies.

**Has your invention been reduced to practice? YES**

Date: [REDACTED]

**Briefly describe any efforts to make a prototype of your invention or to test your invention. Additionally, summarize the results of any related experiments and testing and highlight any results of particular significance.**

Actual working spot lamp and stick lamp modules were constructed utilizing flex circuit and Lumileds Luxeon LED's. The flex circuit was constructed of 1.0oz thermally bonded copper on 2mil Kapton polyimide film. Holes in the polyimide under the devices were created using a commercial ESI PC board yag laser drilling machine.

**BRIEF DESCRIPTION OF THE DRAWINGS**

**Please describe the significance of any pictures, drawings, graphs, diagrams, structures or figures and the type of picture along with the specific view or application to the invention.**

The photos show various spot lamp and stick lamp modules constructed using the described invention.

**CLAIMED INVENTION**

**Please identify novel aspects that should be protected within this disclosure letter.**

A disclosure regarding construction of a spot lamp module as seen in the photos has been filed by GELcore. A disclosure regarding the stick lamp will be written.

**ATTACHED FILES**

LED stick spot lamp.ppt

Pic00001.jpg

Pic00002.jpg

Pic00003.jpg

Pic00005.jpg

DUTY OF DISCLOSURE		
a.	Have steps been taken to put into use, either outside GE or in our own operations?	Yes
b.	Has the invention or a product embodying or using it been sold or offered for sale?	No
c.	If the invention pertains to a process, have any steps been taken to employ the process commercially (e.g., for product production)?	No
d.	Has the invention been described in an electronic or printed publication?	No
e.	Has the invention been described to persons who are not employees of GE?	No
f.	Are there results available of a prior art search pertaining to this invention?	No
g.	Has anyone else associated with the project within GE (marketing, sales, sourcing, etc.) disclosed the invention or offered the invention for sale?	No
h.	If you answered Questions a-g as "NO", is any use, sale, publication, or disclosure of the invention now contemplated?	Yes

**Steps Taken to Put the Invention into Use or Employ the Process Commercially?**

**Describe circumstances(e.g. product name, production of product, use of product or prototype)**

Prototypes of "spot modules" using the flexible interconnect, applied to a planar heat sink have been constructed. In addition, a "post light" four sided LED array prototype has been constructed.

**Who? Name of contact person**

Stan Weaver

**Where? Company Name/ GE Technology Area**

GE CRD

**Country**

US

**When? approximate Date**



**Sold or Offered for Sale?**

**Describe nature of transaction**

**To Whom?**

**By Whom?**

**Where?**

**When?**

**Described in Electronic or Printed Publication, or  
Disclosed in a Talk or Paper Presented at a Public  
Meeting**

**To Whom?**

**By Whom?**

**Within GE or Outside GE?**

**Where? Journal/Meeting/Country**

**When?**

CO-INVENTORS			
Name	Address	Global Tech. Center	Lab
*Charles Becker	1010 Lamplighter Rd Schenectady, New York zip - 12309	(Defunct )do NOT use Ceramics (3700)	Electronic and Op
Stanton Weaver	119 Hemlock Terrace Northville, New York zip - 12134	Micro- and Nano-Structures Technology (5590)	Micro Systems &
Thomas Stecher	2889 Ridge Rd. Scotia, New York zip - 12302	Micro- and Nano-Structures Technology (5590)	Micro Systems &
*Lead co-inventor			

**Primary / Financing Business (or Advanced Technology Program) :**

**Primary / Financing Component :**

**Associated Lab/Program :** (Defunct )do NOT use Ceramics (3700)/Electronic and Optical Materials (3750)

**Assigned Attorney :** Toan Vo